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EDITORIAL NOTES

POST-WAR GAS PROBLEMS

ENEMY action, quick repair of plant and mains, interrupted services, fluctuations in demand, movements of population, and wartime problems generally may be deemed sufficient to demand the whole attention of the Gas Industry at the present time, but it is not too early to begin thinking about what is going to happen when the war is over. Politicians are not the only people who are already visualizing the post-war England. Town planners, architects, transport experts, and builders are studying the problems of the future, and official encouragement was given to this foresight by the establishment six months or more ago of the Ministry of Works and Buildings, with far wider scope than the old Office of Works, which it superseded. Since Lord Reith has presided over the new Department he has been examining, in consultation with experts from most of the interests affected, the gigantic job of re-building England.

In all these new developments the Gas Industry will have its part to play, and it is up to the Industry now to consider how it can render a no less important national service in the coming years of peace than in the months of war. The state of affairs that will confront the Ministry of Works at the end of hostilities will be entirely different from that which existed in August, 1939. For instance, not long before the war began there was controversy about the Bressey report on the re-planning of London. Some of its recommendations sounded then as if they were too expensive to contemplate; others have been rendered obsolete by the trend of events in the last 19 months. The same is true of much of the town planning that was being evolved in 1939. Many of the ideas people cherished at that time have got to be abandoned entirely, but in their place, if this country is to enjoy the full benefits of victory, there must be something much more drastic than was dreamt of before the air war intensified the need for new buildings and cleared sites which may well be used for better buildings than could ever have been accommodated before.

Besides the direct effects of enemy action, the Gas Industry has been affected in a variety of ways. The demands of the fighting services have depleted its ranks of experienced workers, and the prior claim of the State upon the available materials of construction has had its repercussions in the slowing down of expansion and the restricted output of gas appliances. No one can tell quite where the Industry will stand when the war ends, and it is impossible to lay down any lines upon which to base post-war policy; but that does not mean that it can leave the future to look after itself.

Lord Reith is appointing a panel of about 20 representatives of the various interests concerned in post-war development and reconstruction, and the panel will also include four or five staff experts who will be responsible for research. How far the panel will go into the question of gas supply and other essential public services is not yet clear, but in the opinion of an official of the Ministry of Works the public utilities will be the subject of Cabinet consideration. To what extent the Minister will consult the Gas Industry is also not yet certain, but it is obvious that if it is given the opportunity to which its importance entitles it, the Industry can do a great deal towards shaping the England of the future.

Take London, for example. Families have been evacuated to what were deemed to be safer areas. Thousands of business firms have moved their offices anything up to 50 miles out of the capital, and many of them will be reluctant to come back. Trading estates have had mixed experiences; some have so far been immune from enemy attack, and others have borne the brunt of the bombing. The heart of the City has been scarred, and dockland has been badly knocked about. What is to be done about these comparatively straightforward problems, not counting for the moment the innumerable other questions of existing congestion, inner London transport, and so forth? Are there to be new satellite towns around the periphery of Greater London? Is a large slice of London's industry to be transported permanently to the provinces? Are those that do not go right out of the area to be grouped in areas where the employees can either travel easily to and from their work, or live nearby in circumstances in which they can enjoy all the amenities of life? Are the docks to be moved further down the river? Is the business that used to be done within, say, a single street, to continue to be hampered by the necessity for travelling miles in all directions to see people who could formerly be seen in a single morning? Every one of these questions touches the Gas Industry at some point, and the Industry must be re-planned with due regard to the effects produced by their solution.

Slum clearance, smoke abatement, public health and social welfare are all bound up with the same broad question. Even now there are speculators who are keen on buying up bombed sites at low prices in the hope of making fortunes when re-building starts. Such practices are being discouraged, lest transactions hastily entered into at this stage should hamper properly balanced development later on. The trend of post-war re-construction will, of course, have an important bearing on gas distribution, and the Industry must be early in the field to ensure that its mains are where they are wanted. Architecture will have to be considered, and here again, even if gas-works cannot add greatly to the beauty of the landscape, they can at least be planned with due regard to their surroundings, and sited suitably in relation both to pleasing the eye and serving their purpose.

Commercial and economic considerations long since proved the unsoundness of having a great multiplicity of small electrical undertakings serving restricted areas with current at a wide range of usually very high prices, and before the war the Gas Industry, too, was discussing whether larger units were preferable to numerous small undertakings. Amalgamations in various parts of the country had been followed by the closing down of small plants, the centralization of manufacture in modern works, and the laying of ring mains not only to serve existing areas but to rope in the outlying villages and hamlets *en route*. War conditions have compelled some undertakings to seek the help of neighbouring works, and the lessons in the matter of co-operation thus learnt under emergency conditions will undoubtedly form the basis of more complete amalgamation after the war. Some kind of national co-ordination in relation to the changed circumstances may be found to be one of the best ways of restoring the stability of an Industry that has had to bear probably more than its fair share of the effects of the war.

Then there is the question of appliances. The enormous building programme that must be carried out after the war, both as regards private houses and commercial and industrial premises, will call for more appliances than the Industry, under existing conditions, is likely to be able to produce in the time

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required. The Ministry of Works has its own Director of Standardization, and a list of standards has been prepared, including, among many other items, gas-heated ranges, ovens, fish fryers, water heaters. Standardization has never been a popular idea in the Gas Industry, which, while always striving for the best, has been ready and anxious to encourage new ideas, no matter from what quarter they came. But post-war conditions will find the country in a difficult position as regards cost of manufacture, acceleration of output, and supply of materials, and it is to meet these conditions that standardization is finding favour with the Ministry of Works. A good many things besides gas appliances will be standardized, but it does not follow that people will have to live in absolutely identical houses or work in standard offices and works. There will have to be mass production, but not the sort that has given the term a bad name in the past. The idea behind the Ministry's move towards standardization is to raise the standard rather than to bring it down to a lower level, and to make the appliance, whatever it may be, harmonize, as regards quality and efficiency, with the generally higher standard of building which it is hoped will take the place of the present ruins.

The Gas Industry, in general, has much to gain and nothing to lose by devoting some attention now to the changed circumstances it will have to face when peace returns.

FURNACE DESIGN

NEVER was gas more needed for industrial heat treatment processes than at the present time, and we think that the series of articles, specially contributed, on furnace design which we are now publishing will prove useful to many of our readers. They appear to us as sound practical articles, full of hints on the fundamental principles which should be borne in mind when gaseous-fired equipment is being constructed. The first article of the series on this particular subject—actually the Author has previously contributed during the past six months several other interesting articles on industrial gas practice aimed at over all (not necessarily purely thermal) efficiency in working—covered different methods of heating—low-pressure gas and air, pressure systems employing either gas or air under pressure, and pre-mixed gas and air and gas-air proportioning systems. It also dealt with radiant tube heating, the advantages of which are being increasingly realized. Nor did the Author overlook the surface combustion method. As far as we are aware immersion heating owes its development largely—very largely, in fact—to work undertaken in America for some years now. It is certainly increasing in favour in Great Britain, as the pages of the "JOURNAL" testify.

Concerning the design of furnaces we have also endeavoured to keep readers thoroughly acquainted with the progress made—and it has been very great indeed—in the application of special atmospheres, produced from town gas, to the heat treatment of ferrous and non-ferrous metals. In this regard we publish to-day a Paper which appeared recently in *Industrial and Engineering Chemistry*. This Paper is a succinct review of current practice in the application of many types of special atmosphere, not necessarily those having town gas as their source. There is obviously an enormous field for development in this direction.

To-day the contributor of our series on furnace design discusses heat losses, and emphasizes the wisdom of using first-quality refractories even in furnaces subject only to moderate temperatures.

Ventilation and the Blackout

The Society of Chemical Industry (Chemical Engineering Group), jointly with the Institution of Chemical Engineers, held a meeting recently at which Mr. E. W. Murray discussed the question of ventilation, both natural and artificial, in relation to the blackout. Heating and ventilation are, of course, inseparable subjects, and as a promoter of healthy conditions of ventilation gaseous heating, scientifically employed, stands to the fore. It is likely that, on the return of peacetime conditions, gas will play an increasing part in air conditioning in factories and workshops. Some years ago it was stated that the desirable characteristics for the atmosphere of workrooms were: Cool rather than hot, dry rather than damp, varying in temperature rather than uniform and monotonous, moving rather than still; and gas is admirably fitted to satisfy these requirements, which, in common with the Author, we do not consider out of date. The Author came to the conclusion that the conditions for satisfactory ventilation can be briefly summarized as: Temperature of workrooms for very light work not to exceed 65°–69°F., of workrooms for light active work not to exceed 60°–65°F., of workrooms for heavy muscular work not to exceed 55°–60°F.; fresh air supply either by natural or by mechanical ventilation not less than 1,000 cu.ft. of air per hour per person; air movement within the factory 20–60 ft. per minute according to the class of work done and time of year.

Statistical Blackout

We referred last week to the Minister of Information's request that public utility undertakings should postpone the publication of accounts and the holding of annual general meetings in order that valuable information may not reach the enemy. We said at the time that it was difficult to understand the need for such a step so long as no information is given which would be against the public interest. That a similar feeling is animating others in the financial world is evident from the growing weight of opinion that a reasonable supply of information should be available to investors and to the general public not only from the viewpoint of maintaining public confidence, but also to ensure the stability of capital invested in such undertakings. To this end, a deputation of financial editors, headed by Mr. Geoffrey Crowther, Editor of the *Economist*, is to wait on the Chancellor of the Exchequer to-morrow to voice their views on this matter. A preliminary memorandum to the Chancellor expresses alarm at the extension of the "statistical blackout" involved in this step and in the suppression of the monthly overseas trade figures. The virtual ban, it is considered, may well be extended to all concerns whose operations are linked with the war effort.

Highest Qualities of Service

The Gas Industry will surely not be regarded as presumptuous should it manifest a desire to be associated with the Sister Industry in a statement made by Mr. George Balfour, M.P., in his capacity as Chairman of the Midland Counties Electric Supply Company, Ltd. According to a press report of his address to the shareholders at the annual general meeting of the Company (one of several reports of meetings of Electric Supply and Power Companies which have appeared in the columns of *The Times* during the past fortnight), Mr. Balfour said that, "in common with all public utility undertakings, this Company had to operate the services of all its subsidiary companies under conditions which called for the highest qualities of service, and you can judge for yourselves as to the very high standard of service of all our staffs and employees by the results achieved." For months past our pages, as well as the pages of the Daily Press, have revealed to its personnel, and to the general public, in the clearest possible manner, the exercise of "the highest qualities of service" in our own industry. And there, for the moment, the matter must be left—so far as we are concerned.

Personal

Owing to ill-health Mr. W. HEMINGWAY, Manager of the Richmond Corporation Gas-Works, Yorkshire, for 34 years has tendered his resignation.

Obituary

The Chairman of the Bombay Gas Company, Mr. WILLIAM GRAHAM BRADSHAW, passed away at his home at Crawley Down on March 16 at the age of 79. Besides being connected with the Bombay Company, he was a Director of the Oriental Gas Company, while for many years he was associated with the Commercial Gas Company both as Director and Chairman. He was also a Director of the European Gas Company and the Kent Water Works prior to their being absorbed by other concerns. Mr. Bradshaw was on the Star Life Board of the Eagle Star and British Dominions Insurance Company and on the Board of the Midland Bank for 50 years, acting as Deputy Chairman for 40 years. He was also a Director of the Yorkshire Penny Bank.

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The death of Mr. S. A. BERRY, Distribution Superintendent of the Oxford and District Gas Company, occurred on March 17. He was 58 years of age and had served the Company for nearly 43 years.

Julia King

From the number of kind enquiries we have always received, we know that many among the older generation still remembered Julia King. She was a frequent visitor at Gas Industry functions in the lifetime of Walter King—for so long proprietor of the "GAS JOURNAL." Many will, therefore, be sorry to learn of her death on Sunday, March 23, at Kemp Cottage, Colchester, at the age of 80. We are grateful that her passing was a peaceful one, and that up to the onset of her

last sudden and brief illness she continued such normal activities as her years permitted.

After Walter King's death in 1922 the controlling interest in the "JOURNAL" passed to his widow. Though she seldom thereafter had the opportunity of meeting her old friends in the Gas Industry, we can assure them that they were not forgotten. Talking to us of the old days and the old folks was a never-failing source of pleasure to her. Living quietly at Frinton-on-Sea, she interested herself in local affairs, and particularly in the building, completed a few years ago, of a Church to meet the needs of a largely increased population. But to the end her family remained her principal interest in life, the crowning pride and joy of which was the arrival last year of a great-grandson—grandson of her daughter, Edith Holt.

Naturally a keen interest in the "JOURNAL" was inseparable from that which she had in her family, and she invariably claimed the right at the General Meetings of the Company, which she never once failed to attend, to make her little speech of thanks to the Staff for the manner in which they continued year by year to carry on the Walter King tradition. Our fellow-directors, Alfred Harrison and J. A. Morris—lifelong friends of Julia King—together with the whole staff, ask us to record their personal sorrow at the passing of one who was very keenly concerned with the welfare of all. We sons, together with our sister Edith Holt, avail ourselves of the privilege which a "family" business gives us of paying her the tribute she would pe haps most desire—she was the dearest and kindest of mothers.

W. R. K. and C. A. K.

Institute of Fuel

On Thursday, April 3, at the Connaught Rooms, Great Queen Street, Kingsway, London, W.C. 2, at 2.15 p.m., a meeting of the Institute will be held, when Mr. J. G. Bennett (Director, the British Coal Utilization Research Association) will present a Paper entitled "How far is the Approximate Analysis a Reliable Guide to Coal Behaviour?" This will be followed by a discussion. Preceding the above meeting, an informal luncheon will be held in the Connaught Rooms at 12.45 for 1.10 p.m.

On Wednesday, April 30, a meeting will be held at the Royal Victoria Station Hotel, Sheffield, at 2.30 p.m. A Joint Meeting of the Coke Oven Managers' Association and the Institute of Fuel will take place at which Dr. E. W. Smith (Woodall-Duckham Companies) will present a Paper entitled "Research and the Coking Industry," which will be followed by a discussion.

There Will be a Meeting of the General Committee of the National Federation of Gas Coke Associations, at Gas Industry House on April 8, at 10.45 a.m.

The Next General Meeting of the Manchester and District Junior Gas Association will be held on Saturday, March 29, at 2.0 p.m., in the Engineers' Club, Albert Square, Manchester, when the following papers will be read: Mr. P. Sumner, St. Helens, "Alternative Sources of Power on Gas-Works—Peacetime and Wartime"; Mr. A. Ormrod, B.Sc.(Tech.), Oldham, "A Corrosion Problem and Water Treatment."

The Spring Meeting of the North British Association of Gas Managers will be held on April 4 in the Ca'doro Restaurant, Glasgow, at 10.30 a.m., under the Presidency of Mr. R. D. Keillor. Papers will be delivered by Messrs. C. A. Poulson ("The Airdrie Gas Undertaking") and A. Bujnowski ("Wartime Activities in an Industrial Area").

The Annual Meeting of the Manchester District Association of Gas Engineers will be held at the Midland Hotel, Manchester, on Friday, April 4, at 2.30, when a discussion on Wartime Emergency Repair Problems will take place. The following members have consented to recount some particulars of work they have been called upon to carry out: Messrs. Ernest West, W. H. Handley, L. Hartley, J. W. Scott, and D. M. Henshaw. The Annual Luncheon will be held at 12.45 p.m., and the Regional Commissioner (Sir Harry Haig) has accepted the invitation of the President (Mr. T. Reynolds) to be present.

Weston-super-Mare and District Gas Company

A Centenary of Service

A hundred years ago a small gas-works was erected in Gas Street (now Union Street) in Weston-super-Mare and a small private Company called the Weston-super-Mare Gaslight and Coke Company was formed with a capital of £2,500 and fifty consumers. To-day that undertaking is the Weston-super-Mare and District Gas Company with a capital of £411,336, supplying 550 million cu.ft. of gas annually to 18,398 consumers, throughout an area of 125 square miles.

Throughout these years the Company have built up a reputation of unfailing service, which, with a high quality product, has gained for them the confidence of all consumers, while at all times the Directors have kept before them the desirability of keeping the price of gas as low as possible. With this object in view, innovations have from time to time been introduced to adapt the plant to meet modern requirements, and culminated in the introduction in 1937 of a new carbonizing plant to enable them better to supply the needs of the growing district, and make provision for future requirements. The growth of the Company is a romance of local industry.

To mark the centenary of the Company it had been found possible to make a reduction in the charge to consumers. It was also decided that a sum of £500 should be divided among the 249 members of the staff in recognition of their valued services and co-operation.

In 1855 the Company was incorporated by Act of Parliament under the name of the "Weston-super-Mare Gaslight Company." The capital powers of the Company were then fixed at £8,000, divided into 400 shares of £20 each, and the maximum dividend which could be paid was 7½%. The Company was also authorized to borrow on bond the sum of £2,000, after the whole of the share capital had been subscribed and three-fourths of it had been paid up. The powers obtained by the Company were very comprehensive and would not be given to a gas company in these days. Authority was also given to erect and operate a gas-works on a parcel of land to the east of the road leading from Uphill to Ashcombe. This was the site of the gas-works now, largely extended, in Drove Road. This original plot of ground was given the Company free of cost by Mr. H. F. Parsley.

During the whole of the hundred years of its life the Company has had contracts with the Town Commissioners, the Urban District Council, or the Corporation for public lighting in Weston, and for 73 years the whole of the public lighting was done by gas.

The earliest record of the quantity of gas sold relates to 1881, the figure being 36 million cu.ft.; for 1916 the sales amounted to 253 million cu.ft., and last year they exceeded 550 million cu.ft. So far as can be ascertained the Company has never failed to pay a dividend, and except in its earlier years the dividends have been at the modest rate of the maximum which was permitted under the statutory restrictions. This maximum was fixed at 5% in 1901, and still stands as the standard dividend under the basic price provisions.

The employees of the Company number 249 in addition to the 32 on active service. There are 191 co-partners, and 23 men are in receipt of pensions.

Gas Journal Directory, 1941

We very much regret a correction which was made in our issue of March 5, p. 417, with regard to Sheffield. The entry should stand as it is on p. 62 of the 1941 Directory—*viz.*, R. Halkett, D. & G.M., R. Halkett, jun., Assist. G.M. & S.

The Electricity and Gas Committees of Paisley Corporation have both agreed that for the duration of the war the exchange of gas cookers and wash boilers for electric cookers and wash boilers and *vice versa* should be discontinued, tenants of Corporation houses either new or re-let to continue to have freedom of choice provided there are appliances available.

AIR RAID DAMAGE IN GERMANY

A Report by the Ministry of Economic Warfare covering operations in December and January last

IN spite of the restrictions imposed on bombing operations by bad weather there is every reason to believe that the R.A.F. succeeded in inflicting some substantial damage to Germany's war effort during December and January—and that this in fact exceeded the damage which Germany succeeded in inflicting on Great Britain. Reports from Berlin indicate that the raids on Berlin on Dec. 15 and Dec. 20 were the most effective yet. Mannheim was heavily attacked in the week before Christmas. Bremen's turn came over the New Year. Wilhelmshaven was heavily raided in the middle of January. In addition, lighter attacks were made on the Rhineland towns, particularly Dusseldorf.

Berlin

Berlin, like London, is a large city which can take a good deal of punishment without giving the appearance of widespread destruction. Nevertheless, the raids of December have begun to impress on the Berliners the realities of war. Heavy bombs in the Tauentzienstrasse, in the heart of the city, penetrated to the Unterbahn and brought traffic to a standstill on the important stretch between the Wittenberg Platz and Zoo stations, besides damaging shops, blowing the roof off the Tauentzien Cinema and bringing all street traffic to a standstill. The damage was so extensive that it took ten days to clear up in spite of the extraordinary speed and efficiency of the German salvage squads—in which incredible numbers of men are employed in order to hide the effects of British bombs as quickly as possible from the civilian population.

Hits were also obtained on a very important railway junction between the Schoneberg and Papestrasse stations, where the Ring-bahn connects with the Potsdamer terminus station. While railway damage is in most cases quickly repaired, there is reason to believe that this incident caused considerable dislocation by reason of the importance of the sector of the line and the fact that a train was involved. Elsewhere in Berlin, the Police Presidency and the Law Courts suffered some damage, the top floors of the famous Wertheim Department

stores were burnt out and minor damage was inflicted on a number of important industrial establishments.

Mannheim

Mannheim suffered much more heavily. This is the most important industrial and commercial centre of the middle Rhine. The old town of Mannheim proper stands on the spit of land where the river Neckar runs into the Rhine from the South-East. Between the two rivers is the river port of Mannheim and the shipyard of the Schiffs-und-Maschinenbau A.G. which has built many of the steamers which now ply on the Rhine. Just to the South of the old town, which is beautifully planned around the old castle (and was one of the first towns to number its houses and streets by consecutive letters and numbers—*e.g.*, D/6/16), are the main railway station and the extensive engineering works of Heinrich Lanz A.G.

On the East Bank of the Rhine and the North of the Neckar are the industrial suburbs of Waldhof, Kafertal, Neckarstadt, with the Industrie Hafen. In this area are the principal works of the Zellstoff Fabrik Waldhof A.G. pulp and paper combine. Also in this area are important diesel engine and lorry works of the Daimler-Benz group, and the works of the Motorenwerke Mannheim A.G., which produces a somewhat similar range of oil engines. In Kafertal are the works of Brown Boveri, manufacturers of heavy electrical equipment.

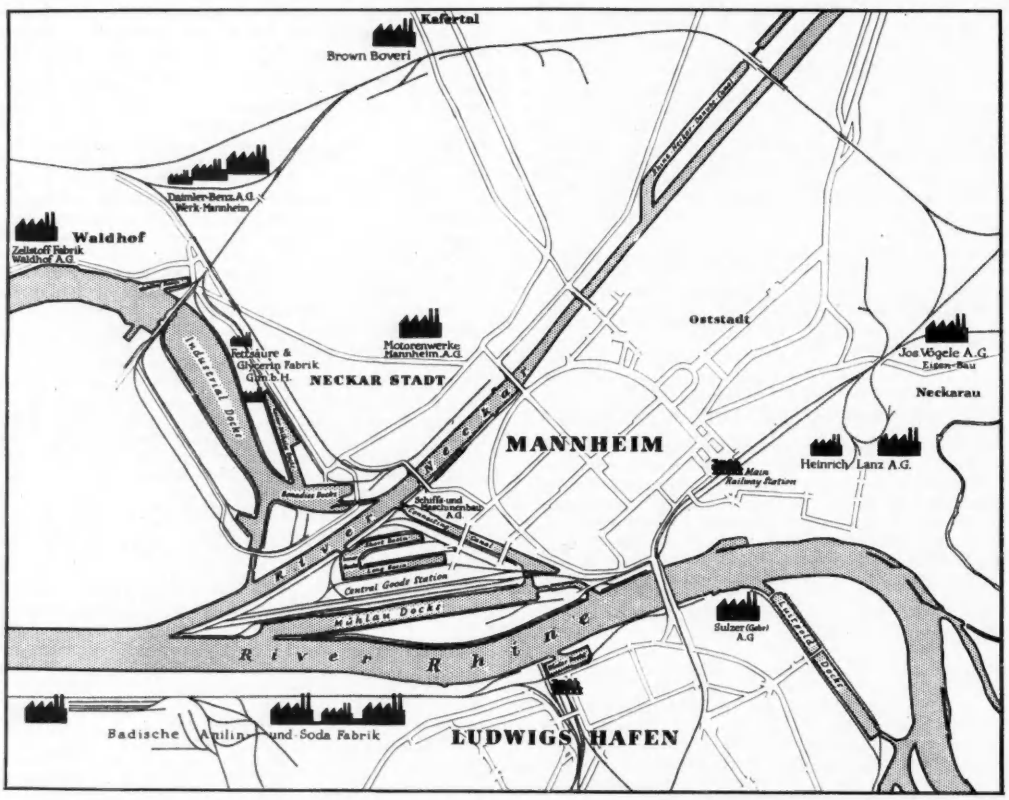
To the South of Mannheim, and still on the East Bank of the Rhine, are the industrial suburbs of Neckarau and Rheinau and the Rheinau inland port. In this area are the steelworks of the Stahlwerk Mannheim A.G., the soap-works of the Sunlicht Gesellschaft A.G., several chemical works, including the important works of the Chemische Fabrik Buckau A.G., and the important electricity generating station (thermal) of the Grosskraftwerk Mannheim A.G. It was in Rheinau that the Bergius oil-from-coal process was first developed. The experimental works is still there and has recently been devoted to the production of sugar from wood on a semi-commercial scale.

On the opposite (West) bank of the Rhine are the towns and suburbs of Ludwigshafen, Oppau and Mundenheim, which rank as part of Mannheim industrial area. Here again there is an extensive inland port, but the chief industrial features are the enormous chemical works in Ludwigshafen and Oppau. The Badische Anilin-und-Soda Fabrik (a branch of I.G. Farbenindustrie) is world-famous for the dyestuffs manufactured in its Ludwigshafen works, which include one of the largest sulphuric acid plants in Germany. The adjacent Oppau works comprise a large synthetic ammonia plant (the first full-scale plant using the Haber-Bosch process to be erected), and an alkali plant, and produce a vast range of heavy and other chemicals. Also in Ludwigshafen is another important engineering firm—Sulzer Bros. of Winterthür. At Mundenheim, the alumina works of Gebr. Giulini constitute an important unit of the German aluminium industry.

Throughout the Mannheim-Ludwigshafen area there are also a large number of smaller engineering works and other industrial enterprises of varying importance.

Mannheim is of importance as a commercial and communication centre no less than as a manufacturing area. The port is the largest inland port in Europe after Duisberg-Ruhrort, and the Ludwigshafen docks claim to be the largest inland port on the left bank of the Rhine. There are the usual flour mills, granaries, seed-crushing plants, oil storage depots, cold stores and warehouses which are to be found at all large distributional centres. As a railway centre, Mannheim is of great importance. Its double bridge forms one of the principal Rhine crossings ; several railway lines converge upon it on either side of the river. And this is one of the chief supply routes for the occupation forces in France.

The raids on Mannheim have inflicted widespread damage to the installations of the main docks; several barges were sunk in one raid and traffic was blocked. The shipyards of the Schiffs-und-Maschinenbau have been damaged and production has been held up. More than one shop of the Heinrich Lanz engineering works has been completely destroyed, and others have been damaged by high-explosive and fire. The damage inflicted on plant and buildings at this works is believed to run into millions of marks, and production is likely to be affected for some time. The Ludwigshafen works of the Badische Anilin-und-Soda Fabrik have been extensively damaged and the Oppau works have also suffered. There is reason to believe that the damage inflicted on these works has set the German chemical industry some difficult problems. Other works, including the Zellstoff Fabrik Waldhof, have received minor damage.



Several hits were scored on the main passenger station and the main goods station at Mannheim. Near the latter a direct hit was obtained on a shed which housed the Central Field Post Office for the Army of Occupation in France, necessitating its removal to Stuttgart. As this occurred shortly before Christmas when the traffic is likely to have been at its peak it may be imagined that the transfer did not take place altogether without friction or delay to the Christmas mail of the troops. In the goods station also, an ammunition train was involved with unfortunate results to surrounding property. Apart from the main station, the Ludwigshafen and Waldhof stations were also involved; the former was set on fire and the engine sheds were also hit. Altogether some 15 hits were scored on railway tracks in various parts of the Mannheim area. One of these broke the connexion across the Rhine between Mannheim and Ludwigshafen for some days. All rail traffic had to be diverted from the Mannheim area and routed through Karlsruhe—not a serious diversion in point of distance, but Karlsruhe is likely to have been heavily loaded already.

Altogether it is clear that industrial life in Mannheim must have been somewhat abnormal for several weeks after these raids.

FURNACE DESIGN

[Contributed]

(*Continued from p. 507*)

It is now generally accepted that size has a distinct bearing on the efficiency of a furnace, and that there are certain limitations in size and capacity beyond which heat wastage begins to increase unduly. Heat losses may be divided into two main classes, (*a*) that lost through walls, crown, and floor, (*b*) losses through the flue outlet. Losses under (*a*) are due to radiation and convection from the outer surfaces of the structure, and since heat will always flow directly from high temperature zones to lower temperatures, the first essential is to calculate the heat losses likely to be experienced through the walls, &c., and to choose materials which will reduce this loss to a minimum. Refractories should have a low co-efficient of expansion in order to withstand frequent heating-up and cooling-off, and must be reliable in both oxidizing and reducing atmospheres. The thermal conductivity must be suited to the position in which it is to be used, and the material must maintain its mechanical strength at all temperatures to which it will be subjected.

Very few refractories are possessed of low heat-conducting properties, therefore no useful object is served by building side walls of excessive thickness. In some cases this is unavoidable in order to provide adequate support for the crown of the furnace. Whereas the heat loss through a 9 in. wall with an internal temperature of 1,100°C. is some 1,420 B.Th.U. per sq. ft. per hour, doubling the thickness of brickwork only reduces the loss to 980 B.Th.U. per sq. ft. per hour—a saving of little importance in the case of a furnace used intermittently when one considers that this mass of brickwork is absorbing heat during the whole period the furnace is in use. Any design which, while not reducing the operative value of the furnace, reduces the weight of heat-absorbing material is to be commended since it follows that less gas will be required to bring the furnace up to working temperature.

With furnaces incorporating the suspended roof principle the weight of refractory material both in crown and walls can be reduced considerably. A further saving in weight and

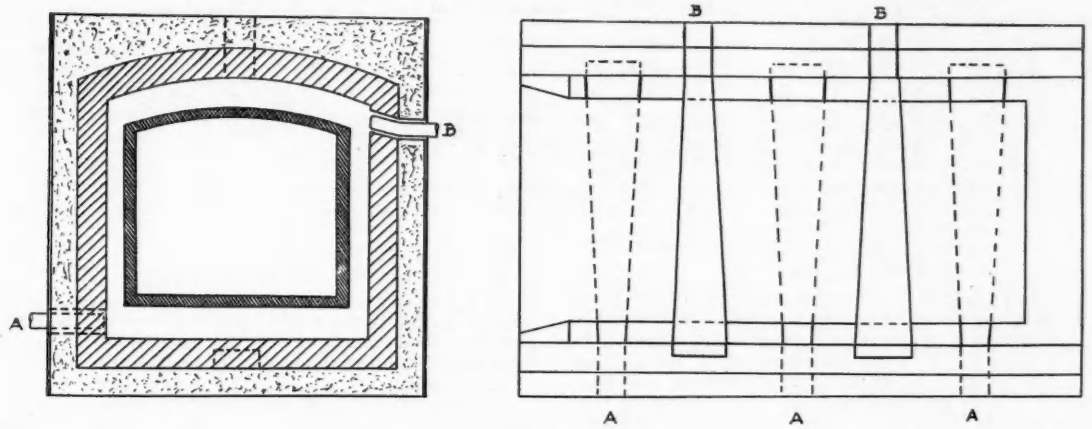


FIG. 2.

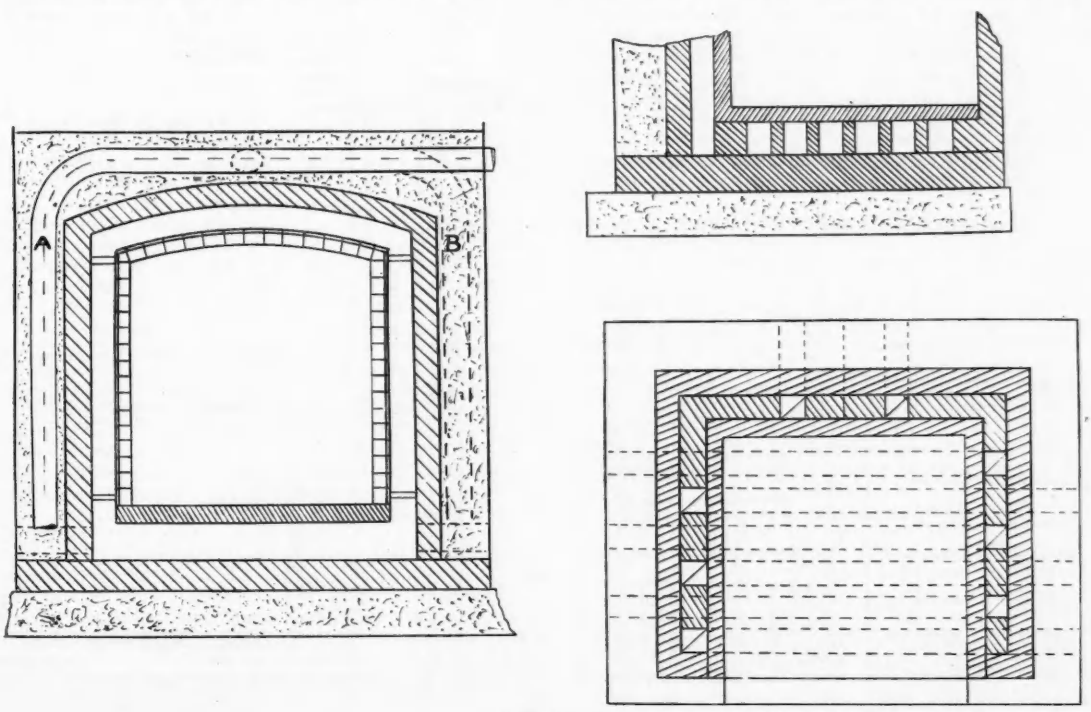


FIG. 3.

materials is effected by forming an insulating air jacket between the thin refractories and the outer panels of the furnace. Instead of passing into the brick structure and being wasted, the heat conducted through the refractories is picked up by the air circulating around the furnace, and can be used either as primary or secondary pre-heated air for combustion. Heat losses through brickwork, which in ordinary furnaces may be as much as 40%, become almost negligible, and if the air jacketing is extended to include the hearth and crown an extraordinary saving in time and gas consumption is experienced.

In furnaces with a sprung arch it is generally necessary to build the interior higher than is actually essential for the load —*i.e.*, the design, and not the requirements, decides the space to be heated. With the suspended roof construction the roof can be flat or arched to suit the work, therefore full advantage can be taken of radiated heat from the roof. In cases where the flame must not be allowed to come in contact with the load, the gas can be burned in tubes suspended directly above the load, thereby retaining in the furnace a higher proportion of the available heat.

When dealing with the heat losses from brickwork attention must be paid to those occurring from the base of the structure. It will be noted that, with the exception of fig. 1, the furnaces shown are all insulated at the base. Careful measurements of surface temperatures of walls and crowns for heat balance calculations often show a wide discrepancy—20% is not unusual —to be accounted for by heat which passes into the ground below. Allowance must also be made for additional radiation and convection losses arising from the continuity, or otherwise, of the furnace operation. This may add a further 4% to 20% to the calculated figure, and therefore calculated figures may be purely empirical unless every detail is taken into account.

The size of flue passages for flames and hot gases is a problem involving velocity, temperature, pressure, frictional loss and draught. From this data a theoretical flue size can be calculated which can seldom be put into practice. Time contact is an essential feature of heat transmission, and flue passages require to be made sufficiently large to keep the gases at the minimum velocity above that which causes baffling or interference with combustion. Except in small laboratory and experimental furnaces, no flueway should have a smaller cross-section than 1½ in.

Fig. 2 shows a muffle type furnace fired over and below the muffle by pre-mixed gas and air burners, the products from which are carried away by passages which increase in area and in the surface of the muffle walls, &c., towards the sides of the muffle. Those carrying the hot gases from the top burners discharge into a common flue in the base, the bottom burners being connected to a similar flue passage in the crown.

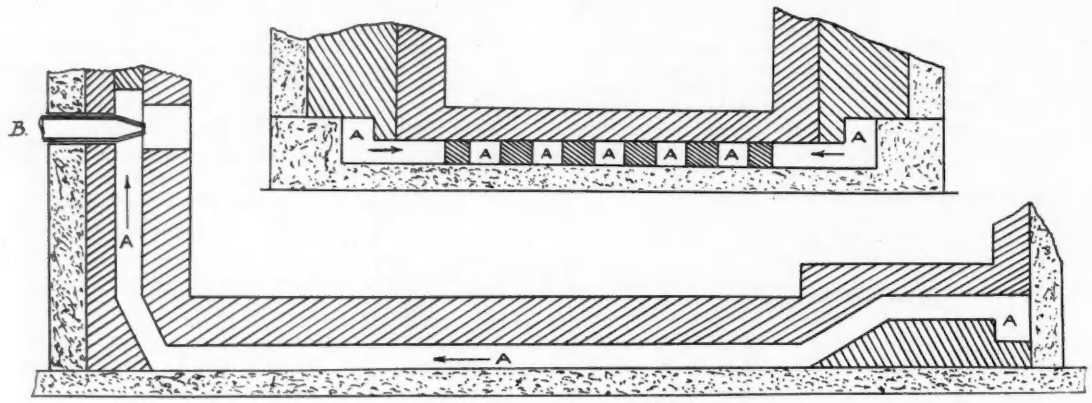
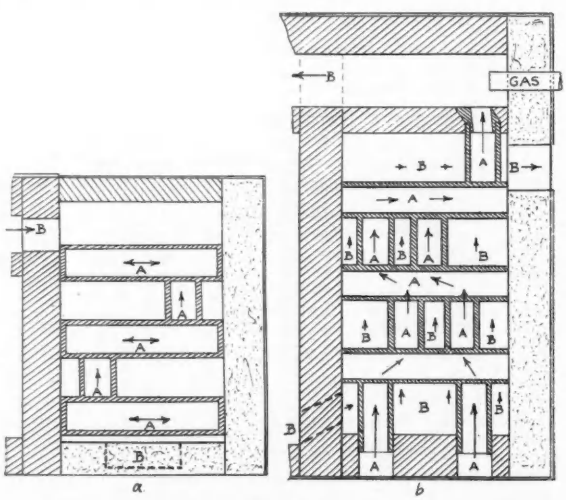


FIG. 4.

Many methods have been devised in endeavours to put to some useful purpose the heat passing into, and stored in, the brickwork of the furnace. Fig 3 shows one method in which a nest of tubes, A and B, is built into the brickwork, secondary air for combustion being circulated through the tubes before coming into contact with the flames. The burners are staggered on each side of the furnace, and immediately above each nozzle an outlet from the tubes directs a stream of air to the flame. As the air is pushed through the tubes by means of a fan there is little time for contact with the heated interior of the tube, and the effect on the air is barely perceptible until the furnace has been in operation for some considerable time.

In fig. 4 a much superior method of heat extraction has been adopted by constructing a series of interconnected flues below the hearth of the furnace. In this instance air is drawn into the flues from controllable inlets on each side of the furnace, and as there is only one burner, B, to feed, and the quantity of air is dependent on chimney pull, a much longer time contact is possible and a definite economy established.

Although heat losses through the flue gases cannot be entirely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eliminated, they can be effectively reduced by utilizing the heat in the waste gases to raise the temperature of the air required for combustion. Only in the larger furnaces does cost and resultant economy warrant the building of regenerators, which can, therefore, be neglected so far as the average size gas furnace is concerned, in favour of recuperators.

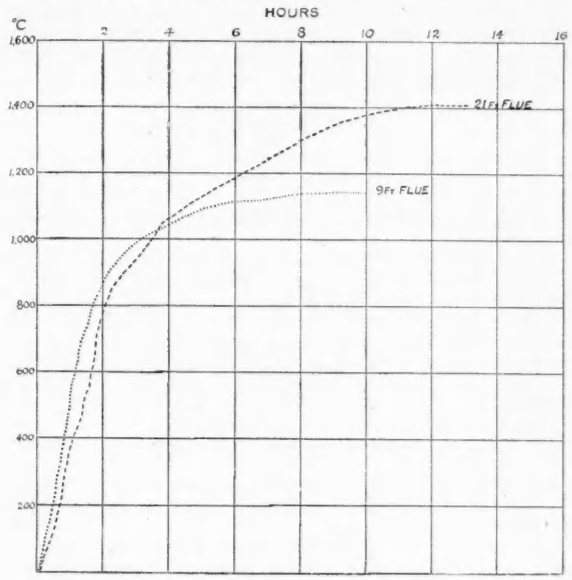

FIG. 7.

As pre-heating of the air for combustion means that a proportion of the B.Th.U. extracted from the waste gases is being returned to the furnace, recuperation must have an effect on furnace performance and amount of fuel required for any particular duty. The actual saving depends upon the degree of pre-heat imparted to the incoming air, and there should be no difficulty in attaining a pre-heat of 500° from a furnace working at 1,250°C., which represents a saving of some 14%. In continuous type furnaces the pre-heating may be carried to within 7% of the heat in the waste gases.

Wherever possible recuperators should follow the counterflow system, thereby gradually heating the air, which, in its passage, will enter first the cooler sections, In this way a higher degree of pre-heating will be obtained, and, in the case of metallic recuperators, prolonged life of the tubes.

Fig. 5 shows sections through two metallic recuperators, (*a*) following the counter-flow principle with the hottest gases B passing around the tubes immediately prior to the pre-heated air, A, entering into the combustion chamber, and (*b*) with the hottest gases, B, meeting the cool air, A, and the two travelling in the same direction towards the flue outlet and the combustion chamber respectively. In each instance the furnace temperature and volume of waste gases are identical, but the temperature of the air at outlet of recuperator (*a*) is 16% higher than that from (*b*), although the recuperator area of the latter is some 20% greater.

Fig. 6 shows an open type furnace, fired by tunnel burners, in which the air, A, is taken first through a metallic recuperator in the extended flue outlet, and then passed around the brickwork at the back and base of the furnace before entering the combustion chambers. As the hot gases enter the flue they are divided into streams and circulate the outer and inner flue passages. A series of baffles in the air passages forces the air against the hot surfaces of the tubes and extends the time contact. Due to the high resistance set up by the tortuous passages through the baffles, such a method is applicable only when air is used under pressure.

Chimneys and flue outlets from furnaces have generally been left as a detail within the discretion of the installation engineer and the user rather than a matter within the purview of the furnace designer. That the flue can serve a more useful purpose than simply to carry away the products of combustion or prevent downdraughts is clearly illustrated by fig. 7, which shows the improved performance resulting from extension of the flue. The furnace in question, a natural draught type, had always satisfied requirements as regards uniformity and temperature until the exigencies of war made it essential that certain components be treated at a temperature some 300°C. higher than that for which the furnaces had been designed. Increasing the gas consumption did not give the desired effect, and further trials showed that the heat could be raised the required amount by increasing the length of flue, and consequently the length of flame and amount of air drawn in through the secondary air ports.

The course of experimental work in this connexion amplified the wisdom of using first-quality refractories even in furnaces subject only to moderate temperatures. Had inferior brickwork been used in the first instance, it is quite probable that the increase in working temperatures would have made it necessary to rebuild the combustion chambers, and, possibly, other parts of the furnace. As a matter of interest, the only outlay by the user was for additional flue-pipe and the stays thereto. *(To be continued)*

PROTECTIVE ATMOSPHERES FOR HARDENING STEEL*

By J. R. GIER, *Westinghouse Electric and Manufacturing Company, Pittsburgh*

WHEN steels are heated for hardening, they become chemically active toward the furnace atmosphere and suffer considerable surface damage unless protected in some way. This damage may consist of scaling by oxidation, decarburization of the underlying metal, or both.

Oxidation can be prevented simply by maintaining a reducing atmosphere in the heating chamber. To prevent both changes in carbon content as well as oxidation, it is necessary to meet certain additional requirements of gas composition that are quite critical. Failure to meet these requirements has caused serious trouble from decarburization when attempts have been made to use ordinary bright-annealing atmospheres for hardening steels; although these gases prevent scale, they do not prevent decarburization. In fact, they seem to increase the depth of decarburization because of the fact that none of the affected metal is removed by scaling.

The problem of preventing decarburization of steels in reducing atmospheres has been studied by numerous investigators. Johansson and von Wachenfeldt[3] showed how mixtures of carbon monoxide and dioxide produced from charcoal could be adjusted to equilibrium with various carbon-content steels. Slowter and Gonser[4] made an extensive study of various gas mixtures, most of which tend either to carburize or decarburize. They found that a synthetic mixture consisting of dry nitrogen and a few per cent. of carbon monoxide was quite inactive toward all carbon contents in steel. Neither of these atmospheres has been adopted extensively for commercial use. The charcoal generator is difficult to operate and control, while the inactive gas requires elaborate processing equipment and special furnaces for using it without contamination, to which it is very sensitive.

Current industrial practice makes use of several different atmospheres for preventing scaling and decarburization of steels during heat treatment. Although they are useful in a limited way, none of these schemes offers a broad general solution of the problem. These atmospheres and their characteristics are described briefly as follows.

The most common procedure involves feeding raw mixtures of air and hydrocarbon gas into the heating chamber of an electric furnace or closed-muffle gas-fired furnace. The gas and air react in the furnace, but complete equilibrium is seldom approached except in high-speed steel-hardening furnaces operating at 2,200° to 2,350°F. In moderate-temperature furnaces the incomplete reaction of the gas components makes it practically impossible to adjust the mixture to balance the carbon in the steel. In the low-temperature range this scheme has proved useful in minimizing or preventing scaling where

* From *Industrial and Engineering Chemistry*.

some change in surface carbon can be tolerated. However, as now used, this type of atmosphere tends either to carburize or decarburize to some extent, its chief advantage being its simplicity and low cost.

Charcoal gas from a generator built into and heated by a high-temperature gas-fired muffle furnace for high-speed steel is now being used. The composition, and therefore the carbon pressure of this gas, is determined by the furnace temperature. This gas is not adaptable to independent control, but is being used with certain types of high-speed steel for which its carbon pressure happens to be correct.

A modified atmosphere composed chiefly of charcoal gas has been developed for use in moderate-temperature furnaces for hardening. This atmosphere is produced in a separate charcoal gas producer; then hydrocarbons and sometimes raw ammonia are added to it. The hydrocarbon is added to offset the decarburizing tendency of the straight producer gas, but no valid explanation of the reason for adding the ammonia is known to the Author. This atmosphere is highly reducing and slightly carburizing. It has given good results in bright hardening high-carbon steel or certain lower carbon steel parts that can tolerate some increase in surface carbon.

Another type of atmosphere that is used for hardening high-carbon steels, particularly tool steels, is one formed by cracking hydrocarbon liquids to give an atmosphere high in hydrogen and carbon monoxide and containing a few per cent. of methane. As this mixture is substantially free of carbon dioxide and water, it tends to be carburizing. It is quite expensive, and is used exclusively in furnaces with gas-tight metal heating chambers.

A recent paper by Gier and Scott[2] described the use of an atmosphere of dissociated ammonia for hardening tool steels. This gas is strongly reducing, even to stainless steels, and is relatively inactive toward the carbon in steel when very dry (dew point below -40°C.). For the necessary purity to be maintained while in contact with the work, it must be used in a metal muffle furnace of special design; this fact, together with its relatively high cost, restricts its application to special work.

While the above-mentioned atmospheres are useful in a limited way, a need exists for an atmosphere that is applicable to the bright hardening of steels of any carbon content in any temperature range. This atmosphere should be cheap enough to use in large continuous production furnaces as well as in small toolroom furnaces. It should be produced in a simple and inexpensive generator that can be easily controlled by the average furnace operator.

An atmosphere has recently been developed and put into industrial service which appears to meet the above specification. It is produced by the endothermic reaction of air and hydrocarbon fuel mixtures in a special generator containing an electrically heated catalyst. For this reason it is referred to as endogas-controlled atmosphere. This gas differs from similarly prepared mixtures in one fundamentally important respect—that is, the completeness of the reactions obtained produce a mixture whose components are in mutual chemical equilibrium and are present in accurately controlled amounts. This condition enables the carbon pressure of the gas mixture to be readily adjusted to balance the carbon in any steel. The gas is formed in a single step and is delivered directly to the furnace from the generator; no intermediate processing such as drying or carbon dioxide scrubbing is necessary. The preparation and use of this atmosphere are described in a subsequent section of this Paper.

Behaviour of Protective Gases

A truly protective gas for steel must meet two important conditions. First, it must be reducing—that is, it must not contain free oxygen at a partial pressure greater than the dissociation pressure of the oxide of the metal. This condition can be met by having a sufficient proportion of the reducing gases, hydrogen and carbon monoxide, relative to the oxidizing components, carbon dioxide and water. (High-chromium alloys will oxidize on slow cooling in atmospheres containing more than a trace of carbon monoxide.) Secondly, it must have a carbon pressure equal to that of the steel. The phrase "carbon pressure" is used here to indicate the carbon-forming potential of the gas and under equilibrium conditions is equal to the fugacity of the carbon in the steel. The meaning of the term "carbon pressure" as used in this Paper may be further explained by a brief reference to the chemical reactions governing the behaviour of the gas towards the steel.

Carburization and decarburization of steel in the types of gases discussed here may be represented by the reaction (Fe, C) + $CO_2 \rightleftharpoons Fe + 2\ CO$ consisting of two separate reactions,

$$(Fe, C) \rightleftharpoons Fe + C \quad (1)$$

$$2\ CO \rightleftharpoons CO_2 + C \quad (2)$$

where the term (Fe, C) represents a solid solution of iron and carbon. This solid solution may be regarded as exerting an immeasurably small carbon pressure (fugacity) which is a function of the amount of carbon in solution and of the temperature. Similarly, the gas phase may be described as possessing a free-carbon component or carbon pressure in equilibrium with the carbon monoxide and dioxide. The concentration of this free carbon (or the value of the carbon-forming potential) is governed by the amounts of carbon monoxide and dioxide according to the mass action law as if it were a gas:

$$(C) = k_2 \frac{(CO)^2}{(CO_2)} \quad (3)$$

where k_2 is the equilibrium constant of reaction 2, and the terms in parentheses refer to partial pressures. In other words, the term "carbon pressure" is used here to mean the carburizing potential of a gas, without regard to the actual mechanism of the reactions.

In a gas mixture where other active components such as methane, hydrogen, and water are present, they can react with the carbon monoxide and dioxide and thereby determine the carbon pressure of the mixture. The critical nature of this balance in heat-treating practice is shown in the following table. Several atmosphere analyses are listed with the corresponding carbon content of steel in equilibrium with these mixtures at 1,700°F.

% C. in Steel at 1,700° F.	Gas Component, % by Vol.					
	H_2O	CO_2	CO	H_2	CH_4	N_2
0.20	1.80	0.4	19.7	35.7	0.7	43.5
0.64	0.50	0.0	20.1	39.3	0.5	40.1
0.94	0.26	0.0	20.4	39.0	0.7	39.9
1.34	0.13	0.0	20.6	38.6	0.9	39.9

The striking fact is that the carbon dioxide content is less than can be measured by ordinary means for medium or higher carbon steel ; and yet it is the carbon dioxide content that in effect controls carbon pressure, as expressed in Equation 3. Consideration of the small but critical amounts of carbon dioxide and water required for balance with the carbon in steel, together with the fact that these can react and change in amount, explains why it is impractical to try to obtain the desired mixture by mixing gas components.

Preparation and Use of Balanced Gas Mixtures

A better solution of this problem has been found by mixing air and a hydrocarbon fuel in controlled proportions, then passing this mixture through an electrically heated catalyst, where it is completely reacted to form an equilibrium mixture of the desired composition. The product so obtained is referred to here as endogas because of the endothermic character of the forming process. In this reaction the hydrocarbons are almost completely decomposed into carbon and hydrogen, which is an endothermic process. The carbon is combined with oxygen to form carbon monoxide; this reaction is exothermic, but insufficient heat is generated by it to balance the above endothermic reaction and supply the losses. The energy deficiency is supplied by an external electric heater. Water vapour and carbon dioxide are present only in the small amounts essential to chemical equilibrium of the gas components.

The nominal composition of endogas is determined by the type of fuel used. Those given in the table are typical of the gas as made from Pittsburgh natural gas with an air-gas ratio of approximately 2.7 to 1. Using this fuel the volume of endogas produced is about twice the volume of air and five times the volume of natural gas used. Accordingly, its cost is very low —about 30 cents per 1,000 cu.ft., including electric power for heating the generator at 1 cent per kilowatt-hour and natural gas at 50 cents per 1,000 cu.ft.

A series of heat-treating experiments were made in the laboratory to learn whether the desired control of gas carbon pressure could be attained by regulating the feed mixture to a suitable generator. The general procedure used in the following experiments was to heat thin sheet-steel specimens in the atmosphere to be tested until a carbon equilibrium was attained. The specimens were then quickly cooled without oxidation in the gas by moving them into a cold extension of the furnace chamber. Their carbon content was calculated from their change in weight during treatment. While the specimens were being heated, dew-point and carbon-pressure gauge readings were taken from the gas flowing through the test furnace.

Air and natural gas were delivered to the generator by a constant-ratio mixing pump. Product gas from the generator was delivered at 200 cu.ft. per hour. Of this volume a flow of 20 cu.ft. per hour was put through the test furnace, 5 cu.ft. per hour each through the carbon pressure gauge and the dew point gauge, and the balance was discharged to waste.

The test furnace consisted of a 2.5-in. i.d. silica tube inserted in an electric resistor furnace; one end extended beyond the furnace body to provide a space for cooling the specimens quickly in the gas. The test specimens were moved in and out of the heating chamber on a tray made of light nickel screen by means of a thin push rod acting through a stopper in the mouth of the tube. Test gas was fed in at the upper end and discharged at the lower end, where it was burned.

The test specimens were Swedish spring steel, 0.006 by 1.375 by 4 in., containing initially 1.2% carbon. A heating period of 1 hour at 1,700°F. was required to reach a carbon equilibrium with the gas, but the actual heating periods used were 2 hours or more.

To determine the relation between the feed ratio of the generator and the carbon pressure of the product gas, a series of specimens was heated to 1,700° F. in various mixtures. As expected, the equilibrium carbon content of the specimens, and accordingly the carbon pressure of the gas, was found to be a sensitive function of feed ratio. Hence by this means it is possible to produce atmospheres of any desired carbon pressure within the range required for the heat treatment of steels without change in surface carbon.

Evidence of a true carbon equilibrium between the steel and the gas was obtained in an experiment in which specimens of steel having widely different carbon content were heated together in the same gas. Two 0.006-in. thick strips of steel, one containing 1.2% carbon and the other containing no carbon, were heated together in endogas for 2 hours at 1,700°F. and then rapidly cooled in the gas. The 1.2% carbon strip had decarburized down to 0.64% and the zero carbon strip had carburized up to 0.64% carbon; thus the point of equilibrium was the same for both directions of approach.

When endogas is used in industrial furnaces, there are two factors that can cause the gas to change in composition after it leaves the generator. One is that the furnace may be at a lower temperature than the generator, which difference tends to cause a slight readjustment in the gas to a new temperature equilibrium. The other is the effect of contamination by oxidizing gases diffusing from the brickwork of the furnace or from the outside. These factors tend to increase the water and carbon dioxide and thereby lower the carbon pressure of the furnace atmosphere relative to the fresh inlet gas. However, this is not a serious matter, since the difference can be offset by making the carbon pressure of the inlet gas correspondingly higher so that it will be correct while it is in the furnace.

Experience has shown that for short cycle heating, as for hardening some steels, an approximate adjustment of the carbon pressure is satisfactory. Where the discrepancy in pressure between the steel and the gas amounts to not more than the equivalent of 0.2 or 0.3% carbon, the rate of carbon transfer to or from the steel is quite slow, particularly at the lower hardening temperatures of 1,450° to 1,550°F.

Since carbon pressure is the primary factor in the behaviour of this gas, there was need for some means of measuring this quality if effective atmosphere control was to be obtained. Since it is a complex quantity that is determined by a carbon dioxide content below the range of measurement by ordinary chemical analysis, it was necessary to develop a device that would be directly responsive to carbon pressure and give a quantitative measure of its value. A device made for this purpose and known as a hot-wire gauge has been described(1).

An alternative method of estimating the comparative carbon pressures of a balanced gas mixture is by measuring their water vapour content by dew point determination.

It appears that the dew point might be used as a measure of carbon pressure. Moisture content, however, is not a measure of carbon pressure but is definitely related to it. In an equilibrium mixture of a given hydrogen content, water will vary inversely with the ratio of carbon monoxide to dioxide and the carbon pressure. Accordingly, an indicating device directly responsive to the carbon pressure of a gas is preferable for the accurate control of protective atmospheres for steel.

Although endogas was developed primarily for protecting steels in hardening furnaces, it is also well suited for use as a diluent or carrier gas for gas carburizing operations. When used for this purpose, enriching hydrocarbons are added to the formal gas after it leaves the generator.

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(2) Gier, J. R., and Scott, Howard.—Meeting of Am. Soc. Metals at Natl. Metals Congr., Chicago, Oct., 1939.
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PATENTS

Inner Lifts of Gasholders

The construction of the inner lifts of gasholders is the subject of a patent (No. 530,553; application date, June 27, 1939) taken out by the Oxley Engineering Company, Ltd., and H. H. Hollis. It is directed towards the inner lift top curb or curbs which join the crown and side sheets together.

An inner lift top curb of splayed angular section has been employed for joining the crown and side sheets together. To strengthen this joint the outer row of crown sheets, and the top row of side sheets have been of greater thickness than the remaining sheets to withstand the various stresses to which this joint and immediate surrounding portion of the lift is submitted. In large gasholders, additional curbs of angular section are provided and usually placed, one on the inside of the crown sheets at a desired distance from the side walls of the inner lift, and the other curb is placed at a suitable distance below the top of the lift and secured to the side sheeting. For further strengthening means, gusset plates are inserted in conjunction with the inner lift top curb or curbs and these are spaced at intervals in between the usual vertical stays which invariably are of I-section.

The above construction, state the patentees, while providing sufficient strength for its purpose, is not always easy to construct, and in any case requires the crown and side sheets adjacent to the joint to be of a considerable thickness to withstand stresses as above stated. Furthermore, while it is considered that the use of thick sheets jointed to the inner lift top curb or curbs provides sufficient resistance to stresses over the whole area occupied by the sheets, there is some little doubt on this point. The object of the patent is to provide a construction that is of a more simple but robust form than hitherto. There is provided in or for the inner lifts of gasholders a built-up top peripheral boom comprising a ring of crown plates jointed to a ring of side plates with gusset plates or other stiffening means extending between the two rings at intervals, the crown and side plates being of a thickness to suit the stresses to which they will be submitted and the whole parts secured together by welding and/or riveting or equivalent fixing means.

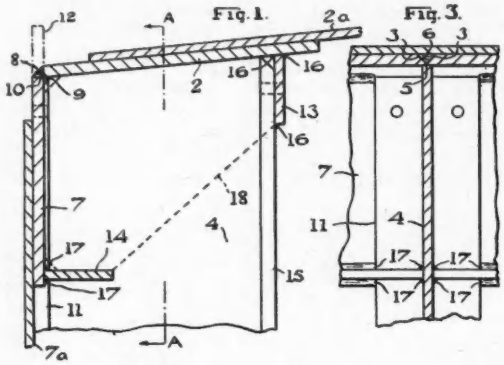
The built-up top peripheral boom may comprise a ring of crown plates jointed to a ring of side plates by a welded joint and further tied together at intervals by means of gusset plates which are secured to the ring plates by welding, riveting, or bolting as desired. Stiffening ribs may be secured to the crown and side plates as desired. The built-up top boom sits down upon, and is secured to, the usual vertical stays which are spaced at intervals around the interior of the side sheeting, and the crown and side plates may be of a strength sufficient to allow the usual thickness of roof and side sheeting to be applied directly thereto without any additional thickness of sheeting at the edges as hitherto.

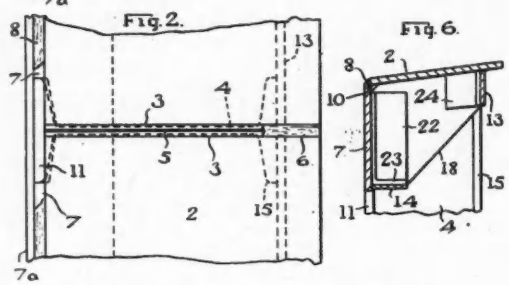
Fig. 1 is a sectional side elevation of a built-up top boom of welded construction; Fig. 2 is a plan view of Fig. 1 with the crown sheeting removed; Fig. 3 is a sectional view of line A, A, of Fig. 1; Figs. 4, 5, and 6 are sectional side elevations of modified forms of built-up top booms employing cleats.

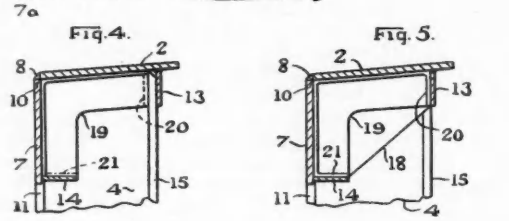
In the welded construction shown in Figs. 1 to 3, the built-up top boom is formed by a ring of crown plates 2 with their ends 3 butt jointed and welded together at such joints. The plates 2 may be slightly curved transversely to suit the curvature of the crown of the inner lift in the usual manner, and preferably, but not necessarily, the joints between the ends 3 of the plates are arranged immediately over the top of the vertical side stays 4. In this manner, when the joints are welded it can be so arranged that the joint is fused to the top of the stay 4. This can be accomplished by chamfering the ends 3 of the plates and allowing a slight crack 5 between the joints for the penetration of the welding deposit 6. A ring of side plates 7 is formed in a similar manner to the crown plates 2, except they are curved in their length, and the two rings are butted together and welded on the outside 8 and inside 9 at the joint 10. The rings are welded together at the joint 10 during the gradual building-up of the rings.

Preferably, the ring of side plates 7 is broken for the interposition of the outer flanges 11 of the vertical side stays 4, or the flanges may be notched to receive the ring of side plates, so that the outer surfaces of the plates 7 are flush with the faces of the flanges 11 of the vertical stays. The plates 7 and stays 4 may be welded together at one or more points. Also, the side plates 7 may be extended above the level of the crown plates 2, as shown at 12, for the usual drainage purposes.

To stiffen the crown and side plates, one or more stiffening ribs 13, 14 are welded or otherwise secured to each plate in any desired position. For example, a stiffening rib 13 projects down from the inner face of the crown plates 2 flush with the inner flanges 15 of the vertical stays 4, and is secured by welding 16, although other means could be employed. Further stiffening ribs 13 may be secured to the crown plates 2 at spaced intervals and arranged to extend between the webs of the various vertical stays 4, or such webs could be notched for the passage of the stiffening ribs. One or more stiffening rubs 14







are secured to the side plates 7 to extend inwardly in a horizontal position (or angular if desired). Such ribs extend between the webs of the vertical stays 4 as shown, or through the webs if so desired, and are secured by welding at 17.

Further strengthening means may tie the crown and side plates 2, 7 together—*i.e.*, gusset plates 18 of angular or other formation are located across the corner at intervals between the vertical stays 4. These gusset plates are welded at their edges to the crown plates 2, side sheets 7, and peripheral stiffening ribs 13, 14 for locking the several parts together and stiffening the whole construction.

A built-up top boom constructed as above allows the crown sheeting 2^a and the side sheeting 7^a to be of uniform thickness throughout the inner lift if so desired.

The crown and side plates of the built-up top boom may be cleated together to retain their formation and position. For example, a cleat of any desired shape may be secured to the web of each vertical stay or bolts, rivets, or welding and also secured to one or both of the boom plates by any of the methods of fixing.

In Fig. 4 the built-up top boom shows a cleat 19 with its flanges secured to the crown and side plates 2 and 7 and to the web of a vertical stay 4. The cleat 19 may be welded, bolted, or riveted in position, or a combination of such fixing means may be employed. If desired, the ends of the cleat could be "boxed" as shown at 20, 21 so as to be secured to the flange 15 and rib 14 respectively. The joint 10 is welded and the plates 2 and 7 can also be welded to the stays 4. Separate cleats may be used for each of the boom plates 2 and 7, to tie the two plates to the vertical stays 4. It will be understood the cleats may be arranged on one or both sides of each vertical stay 4.

If desired the ends of the cleats may be bent or " boxed" to allow them to be secured to the flanges 11 and/or 15 of the vertical stays 4 or to the webs, through suitable angle or other brackets. Furthermore, angle brackets may be secured to the aforesaid stiffening ribs 13, 14 and then to the crown plates 2 and side plates 7.

Fig. 5 shows the gusset plate 18 secured to the plates 2 and 7 by a cleat 19 with "boxed " ends 20, 21 which are secured to the ribs 13, 14. Any of the above methods of fixing may be used for the cleats and ribs.

In Fig. 6 a cleat 22 is used between the gusset plate 18 and the side-plate 7 and furnished with a "boxed" end 23 secured to the rib 14. The gusset plate 18 is secured to the rib 13 by an angle bracket 24 although a cleat 22 could be used. The gusset plate could be further secured to the plates 2, 7 by direct welding or by cleats or brackets.

The construction of the built-up boom may be modified in various ways so long as crown plates and side plates are each arranged to form peripheral rings which are joined together at the desired angle—*i.e.*, slightly splayed from a right angle—and furnished with stiffening ribs when required on their inner faces and tied together by suitably welded, bolted, or riveted tie and/or strengthening means.

Water Gas Cleansing and Cooling

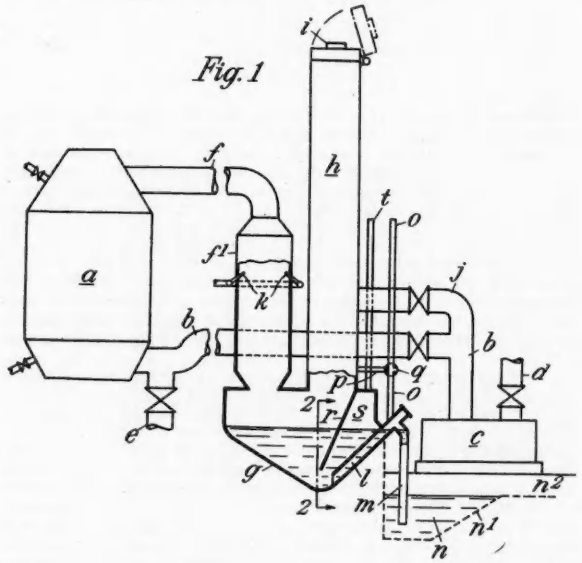
In the manufacture of water-gas it is often essential to cleanse the blast products of the particles and dust carried from the generator, in order to avoid nuisance in the neighbourhood due to their discharge into the atmosphere.

The principal object of a patent taken out by Humphreys & Glasgow, Ltd., and J. H. Smith (No. 532,885; application date, July 31, 1939) is to accomplish this automatically, preferably on or near the ground level while at the same time subjecting the gases to such cooling—if any—as may be desired in the circumstances.

Where a waste-heat steam generator is used, any further cooling is usually immaterial; but, in the absence of waste-heat steam generators, the temperature of the blast gases and of the particles and dust carried by them is usually so high that ignition occurs on discharge to the atmosphere, producing objectionable noise, flame, and general luminosity. The invention described herein may be applied to avoid all such nuisance and danger, as well as the spread of particles and dust in the neighbourhood.

According to the invention the blast gases—and if desired some or all of the water-gas—are passed through a vessel containing and supplied with water in such a manner that the water traps particles and dust which are being carried forward by the gases and water with entrapped particles and dust is periodically expelled from the vessel by an increase of pressure in the vessel. Some of these particles and dust may be carried away by the natural overflow of any surplus water when the level of water throughout the vessel rises sufficiently; but the vessel is preferably so shaped that most of the particles and dust is localized and accumulated as sediment in the lower portion of the bottom of the vessel, whence it is periodically and automatically washed out of the vessel, through a conduit to which all outflow is or may be restricted, by the swift and scouring expulsion of fluid due to the increase of gaseous pressure above the main body of water caused by the cyclical closing of the stack-valve in the ordinary course of gas making. It is obvious that this rapid displacement of sediment-containing water, which results in the expulsion of the cyclical accumulation of particles and dust, requires a minimum supply of water sufficient in the long run to replace the quantity of water thus expelled; but, if the gases are to be further cooled, as may be required in the absence of a waste-heat steam generator, a corresponding additional quantity of cooling water must be supplied; this additional quantity of water may be substantially reduced by its intimate admixture with the gases, preferably before they enter the cleansing and further cooling vessel.

In one arrangement of apparatus according to the invention, the water-gas generator off-take pipe leads downwardly into the top of the cleansing vessel, thus projecting the particles and dust into the water; and another pipe, the lower portion of which serves for the exit of blast gases and, it may be, of water-gas leads upwardly to the stack-valve. The bottom of the vessel slopes downwardly from ends and sides, thus localizing the accumulation of sediment; and the overflow conduit, being open at its bottom and stretching from near the lowest portion of the vessel to the liquid overflow level, compels all of the effluent liquid to be discharged from the lower portion of the



vessel into an outside pipe extending downwardly into a seal pot, the sloping side of which empties into a flume for the ultimate disposal of the sediment; a suitable opening in the top of the conduit prevents possibility of syphonic action exaggerating the discharge of water.

To reduce the quantity of water cyclically discharged by gas making pressure and ensure during the blow period sufficient water within the vessel for efficient extraction of particles and dust, there is provided at the top of the conduit (or outside connection therewith) a pressure

(*Patents continued on p. 559*)

controlling device by means of which the differential in gaseous pressure that produces the cyclical discharge of sediment may be confined to one phase only of the gas making period—that is to say, to either the up-run or to the down- or back-run. When the gas making direction in the generator is reversed, or when some organ of the plant operates it cyclically after the expulsion of the sediment carrying water, the pressure controlling device closes the top of the conduit to atmosphere and opens it to the pressure within the vessel, so that the pressures in the top of the conduit and within the vessel are the same. This equalizes the water levels within the vessel and conduit respectively, and the sudden pressure thus caused in the outer seal-pipe flushes sediment from its seal-pot. Thus water supplied to the vessel until the next predetermined discharging impulse period will be stored therein until it reaches the overflow level established for the efficient extraction of particles and dust from the blast gases.

Referring to the accompanying drawing, fig. 1 shows diagrammatically a side elevation, partly in section, of a water-gas plant of simple form embodying the invention.

a represents the generator the bottom of which is connected by a valved pipe *b* to a washer *c* having a finished water-gas outlet *d*; *e* is a valved air blast pipe connected with the pipe *b* near the generator; *f* is the offtake pipe from the top of generator. The pipe *f* is formed with an enlarged downwardly extending portion f^1 leading into the top of a water containing vessel *g* from which another pipe *h* leads upwardly to the stack-valve *i* through which the blast gases escape to atmosphere. The pipe *h* is connected by a valved pipe *j* to the pipe *b* so that up-run water-gas can be passed through the vessel *g*, the lower part of the pipe *h*, the pipe *j*, and part of the pipe *b* to the washer *c* and thence to storage. *k*, *k* are nozzles through which water is sprayed into the enlarged part f^1 of the pipe *f* to cool the gases entering the vessel *g* and also to provide a body of water in the vessel *g* to trap particles and dust contained in the gases and projected into the water.

The bottom of the vessel *g* slopes downwardly from the ends and sides and is provided with an overflow pipe or conduit *l* extending from near the lowest portion of the vessel to the liquid overflow level, where it communicates with an outside pipe *m* extending downwardly into a waterseal pot *n* having a sloping side n^1 leading to a flume or channel n^2. Particles and dust trapped in the water in the vessel *g* deposit as a localized accumulation of sediment in the lower portion of the vessel and, on an increase of pressure arising in the vessel *g*, sediment-laden water will be expelled through the conduit *l* and pipe *m* into the seal pot *n*. *o* is an upwardly extending pipe leading from the top part of the conduit *l* to atmosphere and having a branch pipe *p* leading into the lower part of the pipe *h*. At the junction of the branch *p* with the pipe *o* is a three-way cock *q* controlling communication between the conduit *l* and atmosphere and the pipe *h* respectively. *r* is a partition extending downwardly from the top of the vessel *g* to about the open lower end of the conduit *l* and from side to side of the vessel. The partition *r* is made gas-tight at the top and sides and its bottom edge is water sealed so that it shuts off from the gas space of the vessel *g* a section or space *s* and this space is open to atmosphere through a pipe *t*. The space *s* thus serves as a reservoir to retain some of the water displaced from the other side of the partition *r* during periods of excess pressure there so that this retained water may return thereafter and contribute to prompt restoration of the general water level in the vessel *g*.

For the sake of simplicity the illustrated apparatus is so constructed that the blast gases and the up-run water-gas only pass directly from the top of the generator to the vessel *g*, but it is to be understood that the apparatus may be provided with one or more generative vessels, a waste-heat boiler, if required, and, it may be, provision for back-running as well as or instead of down-running and that, by the provision of suitable connexions and valves, the back-run gas or the down-run gas may be passed through the vessel *g* in addition to or instead of the up-run gas.

Fame

It happened at 9,000 ft. above sea-level on the left bank of the River Zayul in South Eastern Tibet. So engrossed was I in reading of the journey, described by Hanbury Tracy in the *Black River of Tibet*, of two pioneers exploring the Black River, that I almost lost my breath. If one likes this type of book one does get engrossed, and it is just possible to become so lost in the story that a part seems to be taken in the adventure. Well, this usually happens to me until something more or less violent, perhaps mental or physical, takes place. You will have heard, no doubt, of the food of this part of the world, which seems so messy to us; about the smelling yaks, the wind howling down narrow valleys, the snow, glaciers, rushing rivers, and everything that goes to make a very peculiar and isolated country. There are no luxuries; food is cooked not only by any burnable rubbish available, but by yaks' dung, and the whole inside atmosphere of a room, as well as the food served there, is thoroughly "scented" with the odour. Here, perhaps, one may pause and dwell on gas cookers. But even so there comes occasionally a real shock, whirling one back to one's own everyday life—perhaps even to one's own occupation. Well, at 9,000 ft. altitude the most unlikely happened. The author evidently has a very practical mind, because there in Tibet, in intense cold, as the occasion arises, his mind goes to an intangible something —yet something symbolic of a Great British Industry. On p. 79 the book goes on descriptive of this and that, and then comes a reversion to everyday life: " The hut was built in the open-work style, and I doubt if even Mr. Therm could have coped with the searching draughts . . . . "

Surely Mr. Therm cannot have travelled so far and been longed for so much. Surely his fame is "far-flung" indeed. R. J. R.

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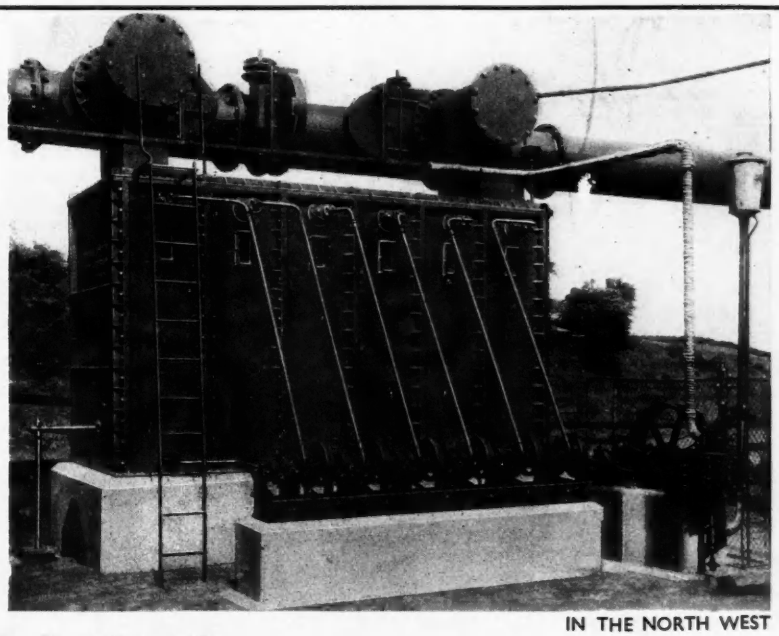

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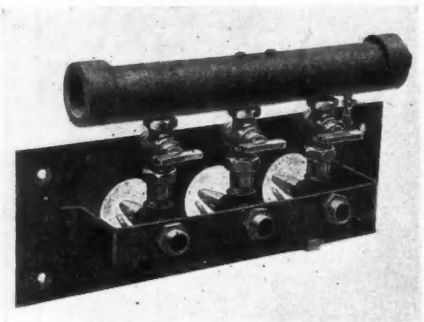
GAS IN INDUSTRY



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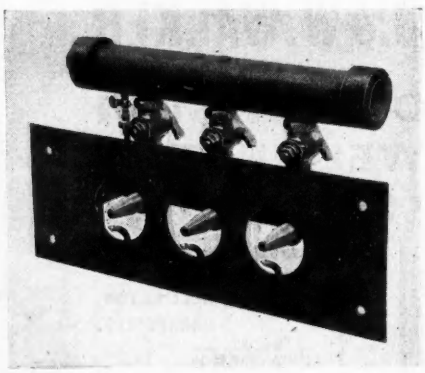

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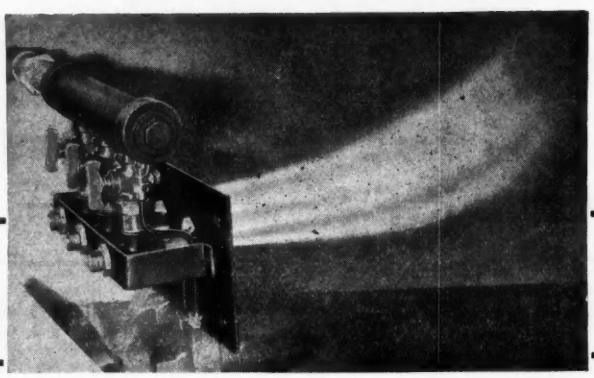

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Gas Products Prices

The London Market

Mar. 24.

There are few alterations to record in the prices of Tar Products in the London Market, which are to-day about as follows: Pitch is nominal; creosote 4¾d. to 5d. per gallon; refined tar 3¾d. to 4d.; pure toluene under the Ministry of Supply Toluene No. 2 Order is 2s. 5d.; pure benzole is 1s. 10d.; 95/160 solvent naphtha is 2s. 3d. to 2s. 6d.; and 90/160 pyridine about 13s. 6d.; all per gallon naked; refined crystal naphthalene £23 per ton in bags; all *ex* Makers' Works.

The Provinces

Mar. 24.

The average prices of gas-works products during the week were: Pitch and Crude Tar,* Toluole, naked, North, 1s. 10d. (controlled by the Control of Toluene No. 2 Order, July 5, which fixes the maximum price at which this material may be sold). Coal tar, crude naphtha, in bulk, North 9½d. to 10d. Solvent naphtha, naked, North, 1s. 9d. to 1s. 10d Heavy naphtha, North, 1s. 5d. to 1s. 6d. Creosote, *ex* works, in bulk, North liquid and salty, 4½d. to 4¾d.; Scotland, 4½d. to 4¾d.; low gravity, 4¼d. to 4¾d. Fuel Grade 4d. to 4¼d. Carbolic acid, 60's, 3s. 9d. to 3s. 10½d. Naphthalene, £15 to £20. Salts, 75s. to 85s., bags included. Anthracene, "A" quality, 4½d. to 4¾d. per minimum 40% purely nominal. Heavy oil: Unfiltered anthracene oil (min. gr. 1,080), 5¼d. to 5½d.; filtered heavy oil (min. gr. 1,080), 5¾d. to 6d.; heavy anthracene oil gr. less than 1,080, 6d. to 6¼d.

* In regard to pitch and crude tar prices we would ask readers to refer to the editorial note in our issue of Sept. 4, 1940, p. 404.

Tar Products in Scotland

GLASGOW, March 22.

Demand for Tar Acids has improved and prices are firmer. Other products remain unchanged.

Refined tar continues to be offered in the home market at 4¼d. to 4¾d. per gallon and for export at 3¼d. to 3½d. per gallon, both f.o.r. naked.

Creosote oil is moving quite rapidly at the following prices: Specification oil, 5d. to 5¼d. per gallon; low gravity, 6d. to 6½d. per gallon; neutral oil, 5¾d. to 6d. per gallon; all *ex* Works in bulk.

Cresylic acid has been in better demand during the week and to-day's values are higher, as follows: Pale, 99/100%, 2s. 2d. to 2s. 4d. per gallon; Pale, 97/99%, 2s. to 2s. 2d. per gallon; Dark, 97/99%, 1s. 8d. to 1s. 10d. per gallon; all *ex* Works in buyers' packages.

Crude naphtha remains steady atround 6½d. to 7½d. per gallon *ex* Works in bulk, according to quality.

Solvent naphtha: 90/160 grade is 1s. 8½d. to 1s. 9d. per gallon and 90/190 Heavy Naphtha is 1s. 4½d. to 1s. 5½d. per gallon.

Pyridines remain weak at about 15s. per gallon for 90/160 grade and 17s. per gallon for 90/140 grade.

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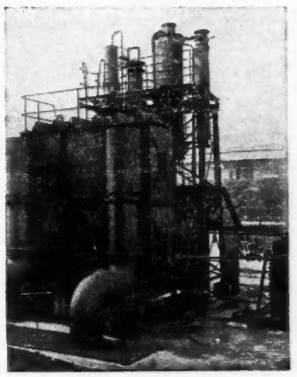
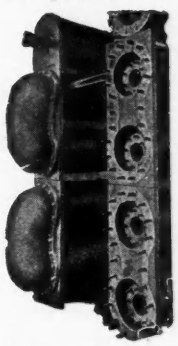


"Permac" Joints in a Gas Works



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GAS STOCKS AND SHARES

It is regretted that, owing to unforeseen circumstances, the Report and Lists did not reach the printers in time for inclusion in last week's "JOURNAL."

Business has been slack in most sections of the Stock Exchange during the past two weeks, and although the undertone has been steady, prices here and there were inclined to weaken. British Funds on the whole maintained their values—2½% Consols, now *ex* div., closing ¼ higher at 77½. Provincial support for home rails led to some improvements, and the market generally was firm. Industrials were quiet and a little irregular, particularly on the news of reduced cement dividends, and towards the close by reason of Jugo-Slavian uncertainties. Oil shares were inclined to weaken in the absence of support, and tea and rubber shares remained neglected.

Gas stocks and shares were comparatively well supported and, with few exceptions, prices continued steady. A few improvements were recorded, notably that of 5½ in Bournemouth 7% stock to 112½ and Watford, which rose 4 to 88½. Tottenham closed 2 points higher at 69½. On the other hand, Gas Light units fell back 6d. to 10s. 6d. There was a time when fluctuations either way in gilt-edged stocks were reflected in the price of this and a few other leading gas stocks, but the prevailing conditions prohibit any comparison for the time being. A feature in the Supplementary List was a sharp drop of 30 in Eastbourne "B" stock to 40. On the Provincial Exchanges, Liverpool improved 1½ to 92, but Bristol and Newcastle ordinaries were marked down 2 points and 3d. respectively.

The Directors of the Colonial Gas Association, Ltd., have declared interim dividends for the half-year ended December 31 last at the rate of 4% on the preference shares and at the rate of 3% on the ordinary shares, both less income tax.

Quotations on the London and Provincial Stock Exchanges

OFFICIAL LIST

Issue. £	When ex-Dividend.	Dividends. Prev. Hf. Yr. % p.a.	Dividends. Last Hf. Yr. % p.a.	NAME.	Quotations March 20.	Rise or Fall on week.
1,767,439	March 10	7	6	Alliance & Dublin Ord. ...	102—107*	—1
374,000	Dec. 30	4	4	Do. 4 p.c. Deb. ...	90—95	...
957,608	Nov. 4	5	5	Assed. Gas & Water U'd'ts Ord.	11/6—13/6	...
500,000	,,	4½	4½	Do. 4½ p.c. Red. Cum. Pref.	14/6—16/6	...
535,545	,,	4	4	Do. 4 p.c. Red. Cum. Pref.	14/6—16/6	...
336,646	,,	4	4	Do. 4 p.c. Irred. Cum. Pref.	10/—13/-	...
561,370	Feb. 17	7	7	Barnet Ord. 7 p.c.	95—100	...
300,000	Oct. 14	1/9⅜	1/4⅜	Bombay, Ltd.	19/6—21/6	...
690,407	Feb. 24	7	7	Bournemouth 7 p.c. max. ...	110—115	+5½
362,025	Dec. 16	4	4	Do. 4 p.c. Deb. ...	87—92	...
659,955	March 3	4⅜	2½	Brighton, &c., 5 p.c. Con. ...	58—68	...
855,000	March 10	6	6	Brit. Gas Light Ord.	70—80*	...
545,000	Dec. 16	5½	5½	Do. 5½ p.c. 'B' Cum. Pref	105—115	...
120,000	,,	4	4	Do. 4 p.c. Red. Deb.	75—80	...
10,000	Nov. 6 '33	6	4	Cape Town, Ltd., 4½ p.c. Cu. Pf.	¼—¾	...
626,860	Feb. 3	6	6	Cardiff Con. Ord.	87—92	...
24,500	Sept. 23	7	7	Colombo 7 p.c. Pref.	19/—21/-	...
764,169	Oct. 7	-/11.48	-/11.48	Colonial Gas Assn. Ltd. Ord. ...	14/—16/-	...
400,000	,,	1/3.30	1/3.30	Do. 8 p.c. Pref. ...	19/—21/-	...
1,748,935	July 22	2	3	Commercial Ord.	28—38	...
620,000	Dec. 9	3	3	Do. 3 p.c. Deb.	57—62	...
286,344	Feb. 17	5	5	Do. 5 p.c. Deb.	85—90	...
807,560	Feb. 24	6	6	Croydon sliding scale	80—85	...
644,590	,,	5	5	Do. max. div.	75—85	...
620,385	Dec. 30	5	5	Do. 5 p.c. Perp. Deb. ...	95—100	...
179,500	Feb. 10	5	5	East Surrey 'B,' 5 p.c.	60—70	...
176,461	Dec. 16	5	5	Do. 5 p.c. Deb. (Irred.)...	87—92	...
250,000	Nov. 11	4	6	Gas Consolidation Ord. 'B' ...	13/6—14/6	...
250,000	Nov. 11	4	4	Do. 4 p.c. Red. Cum. Pref.	15/—17/-	...
19,122,910	July 29	3⅜	4½	Gas Light & Coke Ord. ...	10/—11/-a	—/6
2,600,000	,,	3½	3½	Do. 3½ p.c. max.	38—43	—2
4,477,106	,,	4	4	Do. 4 p.c. Con. Pref. ...	61—66	...
2,993,000	July 8	3¾	3¾	Do. 3¾ p.c. Red. Pref. ...	68—73	...
8,602,497	Dec. 2	3	3	Do. 3 p.c. Con. Deb. ...	70—75	...
3,642,770	,,	5	5	Do. 5 p.c. Red. Deb. ...	101—106	...
3,500,000	,,	4½	4½	Do. 4½ p.c. Red. Deb. ...	99—104	...
700,000	March 10	3½	3½	Do. 3½ Red. Deb. ...	79—84*	—1
5,600,000	May 13	4	8	Imperial Continental Cap. ...	42—47	...
43,820	Jan. 27	3½	3½	Do. 3½ p.c. Red. Deb. ...	75—80	...
231,978	Feb. 24	5	5	M.S. Utility 'C' Cons.	66—71	...
918,657	,,	4	4	4 p.c. Cons. Pref.	70—75	...
675,000	Nov. 11	†4	†4	Montevideo, Ltd.	52—57	...
300,000	Nov. 18	7	9	Oriental, Ltd.	105—115	...
368,537	Dec. 9	8	6½	Plymouth & Stonehouse 5 p.c.	88—98	...
621,667	Feb. 3	7½	7½	Portsmouth & Gosport Cons.	90—95	...
648,999	Sept. 16	1/1	1/1½	Severn Val. Gas Cor. Ld. Ord.	13/—15/-	...
597,972	March 10	-/10⅝	-/10⅝	Do. 4½ p.c. Cum. Pref. ...	15/6—17/6	...
2,528,714	Sept. 2	1/-	-/7½	South East'n Gas Cn. Ld. Ord.	7/—9/-	...
1,000,000	March 3	-/10⅜	-/10⅜	Do. 4½ p.c. Red. Cum. Pref.	13/6—15/6	...
1,068,869	,,	4	4	Do. 4 p.c. Irred. Cum. Pref.	10/—12/-	...
6,709,895	Aug. 5	4	4	South Met. Ord.	39—44	+1
1,135,812	,,	6	6	Do. 6 p.c. Irred. Pref. ...	75—85	...
850,000	,,	4	4	Do. 4 p.c. Irred. Pref. ...	60—65	...
1,895,445	Dec. 30	3	3	Do. 3 p.c. Perp. Deb. .	59—64	...
1,000,000	Jan. 15	5	5	Do. 5 p.c. Red. Deb. ...	98—103	...
1,543,795	Feb. 24	4	2	South Suburban Ord. 5 p.c. ...	55—65	...
512,825	,,	5	5	Do. 5 p.c. Perp. Pref. ...	78—83	...
500,000	,,	4	4	Do. 4 p.c. Perp. Pref. ...	60—65	...
250,000	,,	3¾	3¾	Do. 3¾ p.c. Red. Pref. ...	78—83	...
888,587	Dec. 16	5	5	Do. 5 p.c. Perp. Deb. ...	93—98	...
750,541	Feb. 10	5	2	Southampton Ord.	50—60	...
350,000	Feb. 10	5½	5½	Swansea 5½ p.c. Red. Pref. ...	91—96	...
1,076,495	Feb. 24	5	5	Tottenham & District Ord. ...	67—72	+2
338,555	,,	5	5	Do. 5 p.c. Pref.	78—83	...
453,380	Dec. 9	4	4	Do. 4 p.c. Perp. Deb. ...	76—81	...
1,247,505	May 20	4	6	U. Kingdom Gas Cor. Ord. ...	13/—15/-	...
1,085,952	Nov. 25	4½	4½	Do. 4½ p.c. 1st Cum. Pref. ...	13/6—15/6	...
772,709	,,	4	4	Do. 4 p.c. 1st Red. Cum.Pref.	13/—15/-	...
745,263	Dec. 16	4½	4½	Do. 4½ p.c. 2nd Non.Cum. Pf.	12/—14/-	...
1,200,000	March 17	3½	3½	Do. 3½ p.c. Red. Deb. ...	83—88*	—2
380,606	Aug. 5	7	6½	Uxbridge, &c., 5 p.c.	80—90	...
1,371,138	March 3	4	4	Wandsworth Consolidated ...	65—70	...
2,525,768	,,	4	4	Do. 4 p.c. Pref.	60—65	...
1,343,964	Dec. 16	5	5	Do. 5 p.c. Deb.	92—97	...
383,745	,,	4	4	Do. 4 p.c. Deb.	75—80	...
358,342	Feb. 24	5	5	Watford & St. Albans Ord. ...	86—91	+4
300,000	Dec. 9	3½	3½	Do. 3½ p.c. Red. Deb. ...	84—89	...

SUPPLEMENTARY LIST

Issue. £	When ex-Dividend.	Dividends. Prev. Hf. Yr. % p.a.	Dividends. Last Hf. Yr. % p.a.	NAME.	Quotations March 20.	Rise or Fall on week
351,685	Dec. 16	5	5	Brighton, &c., 5 p.c. Perp. Deb.	88—93	...
28,700	,, 17	5½	5½	Do. 5½ p.c. Red. Deb. 1942 ...	95—100	...
415,250	,, 23	4	4	Bristol Gas Co., 4 p.c. New Deb.	88—93	+5
140,205	Feb. 3	7	7	Cambridge, &c., 7 p.c. Cons. 'B'	100—110	...
295,932	March 3	5	5	Cheltenham, 5 p.c. Cons. Ord....	85—90	...
42,500	Dec. 16	4	4	Do. 4 p.c. Perp. Deb....	75—80	...
150,000	Feb. 24	4	4	Croydon Gas, 4 p.c. Pref. (Irr.)	70—75	+2½
130,000	Dec. 30	4	4	Do. 4 p.c. Deb. ...	75—80	...
146,700	Feb. 10	5½	5½	East Surrey, 5½ p.c. Pref. 'A' ...	80—90	...
53,220	,, 10	6	6	Do. 6 p.c. Cum. Pref. ...	90—100	...
...	Aug. 19	6	4	Eastbourne, 'B' 3½ p.c.... ..	30—50	—30
239,135	Nov. 11	5	5	Gas Consolidation 'A' Ord. (£1)	13/—15/-	...
156,600	Feb. 24	5	5	Hampton C't, 5 p.c. Cons. Ord.	67—72	...
18,000	Dec. 2	7	7	Malta & Med'n., 7 p.c. 1st Pref.	50—60	...
10,845	,, 2	7½	7½	Do. 7½ p.c. 2nd Pref.	50—60	...
50,000	Feb. 24	£5 19 6	£5 4 6	Mid. South. Util., 'A' Cons. 5 p.c.	60—70	...
65,000	Aug. 12	5	5	North Middlesex, 5 p.c. Pref....	87—92	...
70,000	Sept. 9	5	5	Plymouth & Stone., 5 p.c. Deb.	85—90	—2
76,501	Dec. 30	4	4	Reading, 4 p.c. Perp. Deb. ...	70—75	...
74,777	Sept. 30	4	4	Romford, 4 p.c. Debs. (Reg.) ...	77—82	...
21,000	Dec. 16	5	5	Slough, 5 p.c. Perp. Deb. ...	87—92	...
211,740	,, 30	5	5	Southampton, 5 p.c. Red. Deb.	90—95	...
363,575	Dec. 30	5	5	Tottenham, 5 p.c. Reg. Red. Mt.	94—99	...
202,019	Oct. 14	6½	6½	Tunbridge Wells, 4 p.c. Scale ...	67—72	...
135,257	June 10	5	5	Uxbridge &c., 5 p.c. Perp. Deb.	88—93	...

PROVINCIAL EXCHANGES

					Quotations March 14.	
804,948	March 10	5	5	Bath Cons.	94—98*	...
122,577	July 22	7	6	Blyth 5 p.c. Ord.	100—105	...
1,667,250	Feb. 24	5	5	Bristol, 5 p.c. max.	84—86	—2
120,420	Dec. 16	4	4	Do. 1st 4 p.c. Deb.	92½—94½	...
415,250	,,	4	4	Do. 2nd 4 p.c. Deb. ...	91—94	...
3 28,790	,,	5	5	Do. 5 p.c. Deb.	107—110	...
157,150	Feb. 3	5	6½	Chester 5 p.c. Ord.	98—101	...
92,500	Dec. 16	4	4	Do. 4 p.c. Pref.	79—81	...
36,430	,,	3½	3½	Do. 3½ p.c. Deb.	79—84	...
41,890	,,	4	4	Do. 4 p.c. Red. Deb. ...	93—97	...
542,270	Feb. 10	6	9	Derby Cons.	98—103	...
55,000	Dec. 16	4	4	Do. 4 p.c. Deb.	75—80	...
10,000	Aug. 19	10	10	Great Grimsby 'A' Ord. ...	155—165	...
6,500	,,	10	10	Do. 'B' Ord. ...	155—165	...
79,000	,,	10	10	Do. 'C' Ord. ...	145—155	...
732,000	Feb. 24	4	4	Hartlepool G. & W. Cn. & New	61—63	...
2,167,410	Feb. 17	6	6	Liverpool 5 p.c. Ord.	91—93	+1½
245,500	Dec. 16	5	5	Do. 5 p.c. Red. Pref. ...	97½—100½	...
306,083	Jan. 15	4	4	Do. 4 p.c. Deb.	98—100	...
20,000	Dec. 23	5	5	Long Eaton 5 p.c. Pref. ...	9—11	...
80,000	,,	5	5	Do. 5 p.c. Deb.	87—92	...
2,430,267	Feb. 10	5	5½	Newcastle and Gateshead Con.	16/9—17/9a	—/3
682,856	,,	4	4	Do. 4 p.c. Pref.	79—81	...
776,706	Dec. 23	3½	3½	Do. 3½ p.c. Deb.	80—85	...
277,285	Oct. 21	5	5	Do. 5 p.c. Deb. '43 ...	97—102	...
274,000	March 17	5	5	Newport (Mon.) Ord.	87—91*	—2
13,200	Sept. 16	8½	7	Pontyp'l Gas & W. 10 p.c. 'A'	11½—12½	...
13,600	,,	6	5	Do. 7 p.c. 'B'	9½—10½	...
40,000	,,	5	6	Do. 7 p.c. 'C'	9½—10½	...
106,280	Feb. 3	10	10	Preston 'A' 10 p.c.	157—167	...
188,219	,,	7	7	Do. 'B' 7 p.c.	113—122	...
1,806,339	Feb. 24	6½	6½	Sheffield Cons.	111½—113½	—1½
95,000	Jan. 6	4	4	Do. 4 p.c. Deb.	96—98	...
332,351	Feb. 3	6	6	Sunderland 6 p.c. max. ...	107—110	—1
192,150	Feb. 12	5	5	Weston-super-Mare Cons. ...	79—84	...
64,338	Dec. 30	4	4	Do. 4 p.c. Deb.	80—85	...
33,340	,,	7½	7½	Do. 7½ p.c. Deb.	135—140	...

a.—The quotation is per £1 of Stock. * Ex. div. † Price free of income-tax.

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of a conqueror

Shakespeare

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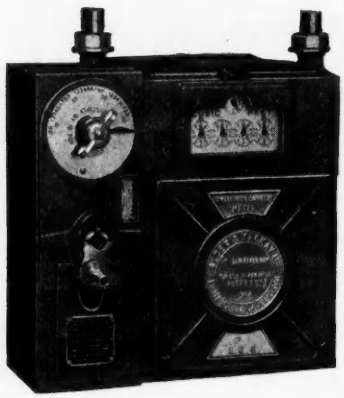

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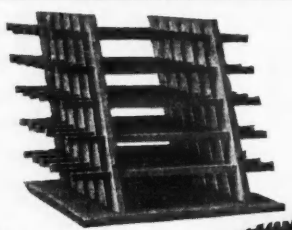

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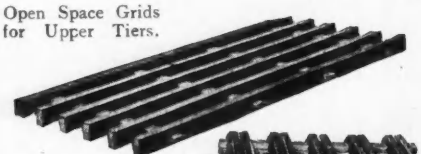
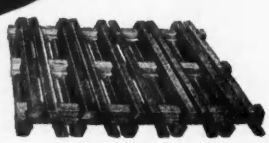
Scrubber Grids.

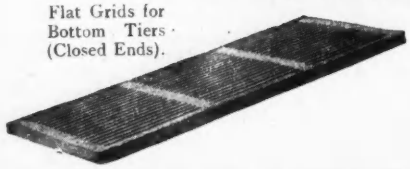
Open Space Grids for Upper Tiers.





Patent Double-Barred Grids.

Flat Grids for Bottom Tiers (Closed Ends).



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